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DRAWINGS ATTACHED

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(19)

(54) A SECURITY SYSTEM FOR CONTROLLING ACCESS TO A PLURALITY OF ENCLOSURES

(71) We, ELECTROSEC CONTROLS LTD., a corporation organised and existing under the Laws of the Province of British Columbia, Canada, of 1700—777 Hornby Street, City of Vancouver, Province of British Columbia, Canada, do hereby declare

the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an electronic security system for use in, for example, buildings, having a plurality of enclosures, such as hotels, having a large number of rooms required to be locked. The security system according to the invention is intended to replace the conventional key and lock system now in general use in such buildings. While the discussion of the invention contained herein is directed to its use in a hotel, it will be understood that the system could be used in any institution requiring a large number of rooms to be locked, or having a number of enclosures, or to which unauthorized access is not permitted. In addition, the system could be used in association with other enclosures, such as security lockers or deposit boxes, and the word "room" is intended to include such enclosures.

The lock-and-key system now used employs the pin-tumbler method and has remained substantially unchanged for many years. Due to the general inflexibility of this system, however, it is vulnerable to those persons who desire to gain unauthorized access to rooms. For example, some employees have master keys which will operate some of the locks in a particular building, and the connivance of such employees with burglars is one of the hazards confronting hotel management. Moreover, a previous user of a room may have taken a key away with him, or may have had a key made from an authorized key.

In addition, the use of security measures poses the risk of offending registered guests, especially in larger hotels where large transient population renders difficult the recognition of individuals.

These and other problems inherent in the use of known locking systems are overcome by the electronic security system according to the invention.

The security system according to the present invention comprises a plurality of portable data-bearing devices each bearing a unique set of data; a computer having a memory location dedicated to each enclosure, means for receiving anyone of the data-bearing devices and for simultaneously receiving enclosure identification data to direct the data of the received data-bearing device to the memory location of the enclosure identified by the received identification data, a bolting mechanism for each enclosure for normally bolting that enclosure and electrically connected to the computer, and a reader associated with each of said bolting mechanisms to receive any one of the data-bearing devices in which when one of the data-bearing devices is inserted into the reader, signals corresponding to the data are transmitted to the computer where the data is compared with the data stored in the memory location of each said enclosure and, if the data being compared matches, the computer issues a signal to operate the bolting mechanism to allow access to the enclosure.

More specifically, the present system comprises a security system for controlling access to a plurality of enclosures, comprising a plurality of portable data-bearing devices each bearing a unique set of data; a computer having a memory location dedicated to each of said plurality of enclosures; a control data entry unit including means for receiving individual ones of the said data-bearing devices and for sensing the data borne by a said data-bearing device received thereby and means for entering enclosure identification data for any of the enclosures, said control data entry unit upon sensing the data borne by a said data-bearing device and upon enter-

ing of enclosure identification data therein, acting to produce outputs in accordance with the sensed data and enclosure identification data; means for connecting the output of said control data entry unit to said computer to provide storage of the sensed data at the memory location within said computer in accordance with the enclosure identification data contained in said outputs; a bolting mechanism for and at each enclosure for normally bolting that enclosure, including a solenoid for controlling the release of said bolting mechanism; reader means located at each enclosure for receiving anyone of the said data-bearing devices and for sensing data borne by the received data-bearing device and for producing outputs in accordance with the data sensed; means for connecting the outputs of each said reader means to said computer, said computer being programmed to identify the sensed data output received from a said reader means with the corresponding enclosure, to compare the sensed data received from that reader means with the corresponding data stored at the memory location dedicated to the corresponding enclosure, and if the sensed data and the corresponding data match, to produce an output signal to actuate the lock release means of said corresponding enclosure to release the bolting mechanism associated therewith to allow access to said corresponding enclosure, and in which said control data entry unit includes a register for receiving the enclosure identification, and means for initiating the operation of the computer to cause the storage of any data being sensed by the control data entry unit in the computer memory section dedicated to the identified enclosure.

In the security system according to the invention, access to an enclosure such as a room, for example, is controlled by a central control unit comprising the computer and located at the front dask or at some other convenient location. The use of the modifier "central" with relation to the control unit does not necessarily mean that the control unit is physically centrally located with respect to, for example, the building, but rather that the control unit is electrically central to the security system. On registering a guest is given one of the small data-bearing room access devices. It will be appreciated that such a device may be of any convenient shape or manufacture, the only requirement being that the device be capable of containing data information which may be sensed, for example, electronically, magnetically or optically. For psychological reasons, however, where the security system is used in a hotel, it may be desirable to have the device in the form of a key, since hotel guests are accustomed to the use of keys.

The data bearing key for use in gaining access to any given room is selected upon registration at random from the group of such keys, each key in the group having a unique set of data to distinguish it from other keys in the group. Before giving the key to the guest, the clerk puts the key into a receiving means in the form of a control data entry unit, and the room number assigned to the guest is also entered in any suitable manner, such as by means of pushbuttons. The control data entry unit is equipped with means to sense the data on the key and to enter the data from the key inserted into it into the memory location in the computer which corresponds to the room number assigned to the guest. A person wishing to gain access to a room puts his key into the data bearing key reader which may be outside the room door. This reader reads the data of the key and transmits it to the central control unit, where it is compared with the data previously assigned to the particular room.

If the data match, the central control unit transmits a confirmation signal, which in the preferred embodiment effects release of the bolting mechanism, allowing access to the room.

In addition to this, the basic system may be modified or augmented. For example, data-logging equipment could be attached to the computer to compile and required statistics.

An example of this invention is diagrammatically illustrated in the accompanying drawings, in which

Figure 1 is a block diagram of a security system according to the invention,

Figure 2 shows a key for use in the system,

Figure 3 is a block diagram of a control data entry unit,

Figure 4 is a schematic diagram of a key reader,

Figure 5 is a schematic diagram of a central control unit,

Figure 6 is a diagram of a bolting mechanism employed in the system,

Figure 7 is a diagram of a panel control unit, and

Figure 8 is a diagram of one of a number of blocks contained in the panel shown in Figure 7.

The block diagram of the security system shown in Figure 1 illustrates the inter-relationship between the various parts of the system. For simplicity and clarity, three rooms only are shown, although it will be appreciated that the system could control any number of rooms. A control unit 1 is central to the system. Before giving a portable data-bearing device in the form of a key to a guest, a clerk, via pushbuttons inserts the room number into a control data entry unit 2, and inserts the key which bears a unique set of data into means within the unit 2

which senses the data contained in the key. This data, plus the room number, is transmitted to the computer 1, and is stored in a memory location corresponding to the room number.

The data for any particular room is stored in the predetermined memory location until such time as it is removed. This is accomplished by assigning a different key to this room, the computer being programmed to remove the previously stored data before entering the data contained on the different key. Where a room is to remain vacant, a particular key is inserted into the control data entry unit, this key containing data which effects removal of the stored data from the predetermined memory location assigned to the room and leaves that memory location blank.

To gain access to the room, the key is inserted into a key reader 3 associated with that room and conveniently located in the vicinity of the room, e.g. adjacent the door frame. The data contained in the key is transmitted to the control unit 1, where it is compared with the information contained in the memory location corresponding to that room number. If the two sets of data match, the control unit 1 sends a release signal to a door release solenoid 4 which then effects release of a latch bolt of a door bolting mechanism, allowing access to the room. An optional data print-out unit 5 could be used to compile any statistical data required.

Figure 2 illustrates a key forming a part of the system of Figure 1. Many different forms of keys could be used for this purpose. The key 10 in the example of Figure 2 consist of a predetermined array of spaced apart conducting slugs 9 mounted in a non-conducting body to provide electrical continuity from one side to the other. The key reader circuit (described below with reference to Figure 4) senses the presence or absence of a slug in any particular location. In the key shown, the pattern used is a row-column configuration, the use of which enables large amounts of information to be contained in a small object. The use of a five-row three-column pattern shown permits the unique identification of 32760 different keys. It will be apparent to those skilled in the art that there are many other possible ways of arranging the information and of carrying the information in keys. For instance, the desired pattern could be arranged by punching holes through an opaque key body, the holes then being read optically using, for example, a light source and photodiodes. Similarly, it is apparent that the key could be designed for "either way up" operation or "right way up" only.

In the preferred embodiment illustrated, the column 7 of slugs and holes identifies the class of key, (i.e. master, maid, guest) and the columns and rows 8 of slugs and holes contain the data information identifying the particular key.

In Figure 3 is shown a block diagram of the key data entry unit 2. Before giving a guest key selected at random to a guest, the clerk inserts the key in a key data reader 11 of unit 2. This reader includes an array of contacts each in a separate electric circuit designed to be closed when a slug is inserted between the points, and thus being capable of determining either the presence or absence of a slug in each position of the array. The room number is punched on a pushbutton board 12, of the unit 2, and transmitted into a register 14 of the unit 2. Associated with this register are verify read-out units 13 on a panel the appropriate of these displays the information entered on the pushbutton board 12 to enable the information punched on the board 12 to be checked. The unit 13 may be in the form of a data display unit adapted to display information transmitted to it by the computer. The clerk next pushes a read command button 15 which initiates the operation of a computer 16 in the central control unit 1. The computer 16 stores the key data received from the key data reader 11 into a memory location previously assigned to the room number contained in register 14, which is also transmitted to the computer.

Shown in Figure 4 is the circuit of the key reader 3. It will be appreciated that each guest room door in the hotel will be equipped with one of these readers. In the circuit shown, when a key is inserted, a forward tip 6 of the key (see Figure 2) closes contacts A. This places a direct voltage on one input terminal of AND gate 18 which is "enabled" by the complementary output of one-shot unit 54, thereby putting a direct voltage on a "request service" line 51, and also through a preset circuit 17, presetting a shift register 19 to register all *0*'s except a *1* in the first position. Contacts S_1, S_2 . . . S_n are opened or closed, depending on the presence or absence of slugs in particular locations of the key.

Further discussion of this circuit is carried out with reference to Figure 5, in which is shown the circuit of the central control unit. For simplicity, only three service request lines and associated circuitry are shown, although it will be appreciated that there would be such a line for each room. The computer 16 senses a direct voltage on one of the "request service" lines 51 through an OR gate 25 and sequentially examines the lines 51, using device selectors 26, together with AND gates 57 and OR gate 59 to determine which line is requesting service. Each device selector, as is customary, is connected to the computer in such a manner that it will only produce a logic 1 output when it receives an assigned code from the computer. As a result, when the

computer applies a code to the device selectors, only the device selector set to respond to that specific code will produce a logic 1 output. Thus, only one AND gate 57 will be enabled at any particular time. When a reader line carrying the direct voltage is located by its device selector 26, its AND gate 57 and the OR gate 59, the memory flip flop 58 associated with that line is toggled thus closing a corresponding solenoid selector switch, S_a, and input selector switch, S_b, for a register 28, and a clock output selector switch, S_c. At this time the computer interrogates the key reader which is requesting service by commanding a clock generator 27 to generate clock pulses in the form of keyed tones which are sent to the reader via a clock line 60. These keyed tones are demodulated in a clock tone demodulator 52, see Figure 4, which then applies clock pulses on line 61 to the shift input of the shift register 19. The shift register 19 is a series of set-reset flip-flops. The clock pulses move the 1 bit along the shift register one position for every pulse received from the clock tone demodulator, so providing each of the AND gates 20 in turn with a logic 1 at one of its inputs so that any gate 20 which has a logic 1 received from the key at its other input can produce a logic 1 output which is fed to register 28. A second output of the clock generator 27, in the form of pulses on line 62 provides the shift input to the shift register 28, Figure 5. A data input to shift register 28 on line 63 is provided by the output of AND gate 53, through the appropriate request service line 51 and switch S_b. The AND gate 53 will conduct whenever one of AND gates 20 conducts, which occurs whenever a conducting slug is present between the associated contacts S_n and the associated position in the shift register 19 is actuated. The other input to the AND gate 53 is provided by the one shot unit 54, and the inverter 55. The one-shot unit 54 is toggled by the reception of the first clock pulse, and it remains toggled for a sufficient time to allow the complete transmission of all the data sensed by the reader from the key. For the key having the 5-row 3-column pattern, discussed above with reference to Figure 2, it is necessary to transmit fifteen clock pulses to the key reader to do this. Each time a conducting slug is sensed in a particular location an input signal is provided at shift register 28, through the appropriate AND gate 20, AND gate 53, line 51 and switch S_n. The presence of the slug is then registered in shift register 28, and the information in the register is advanced by the receipt of the next clock pulse. Once all positions on the key have been examined, the data contained in the shift register 28 is transmitted on multi-conductor data bus 64 into the input gates of the computer 16. The filters 56 prevent clock tones from leaking onto adjacent clock lines and causing unwanted interrogation of other key readers. Filter 610 prevents the clock tones from interfering with the operation of the logic circuits.

The computer 16 is programmed such that upon receipt of the data from the shift register 28, the computer compares the data with the stored data previously assigned to the room whose reader is being interrogated. If the two sets of data correspond, the computer 16 effects closing of switch S_d, thus completing a circuit through S_d, and S_c to the bolt releasing solenoid (discussed below with reference to Figure 6) for the particular room. At the end of the above releasing routine, the memory flip-flop 58 which was toggled is reset to a logic zero by the computer through the common line 65.

It will be apparent to those skilled in the art that additional features could easily be added to this system. For example, where the key data did not correspond to the stored data, an alarm signal could be activated. In addition, the key reader circuit could be designed to partially "pop-out" the key when the data reading is complete, thus preventing repetitive unnecessary servicing by the computer. Also, a data print-out unit could be tied into the computer to allow statistical data to be compiled as or if required, for example to record the time at which a particular door is unlocked, and by what class of key. When the computer has completed a key reading and has taken the appropriate action, it resets the memory flip-flop 58.

Figure 6 illustrates a bolting mechanism of the system according to the invention. A person wishing to gain access to a room inserts a key 10 into the key reader 3 of that room. Providing it is an authorized key, door release solenoid 4, which is located in door frame 34, will be energized by a signal to withdraw bolt 35 from recess 36 in the edge of door 37. When the bolt is fully withdrawn from the door, a bolt-retaining latch 38 is moved by spring 39 into notch 40 of the bolt to retain the latter clear of the door. At the same time, button 42 which is connected to the latch, is moved outwardly to project a little from frame 34 towards the door. The door is now free to be opened. A door knob 43 can be provided on the outer surface of the door, but it does not have anything to do with the releasing of the door.

When door 37 is closed, it engages button 42 and moves latch 38 out of notch 40 so that spring 44 moves bolt 35 back into the door recess 36 to bolt the door.

Egress from the room is obtained by turning the inside door knob 45 which turns a cam 46 to move a spring-loaded rod 47. This rod projects into recess 36, and when moved in this manner, the rod shifts bolt 35 out of

the recess until it is engaged by latch 38, thus freeing the door.

Figure 7 illustrates a panel which is located at the front desk and which would replace the usual panel which holds room keys. On such a panel is located the key data reader 11, the pushbutton board 12 and a read command button 15, all discussed above with reference to Figure 3. The panel also contains verify readout units 13 one for each room. A group of keys could conveniently be located in a receptacle identified generally as 72.

In Figure 8 is shown an enlarged drawing of one of the individual block units 13 for use in the panel of Figure 7. This unit 13 contains a room number 74, adapted to be lighted whenever the associated number is entered via the pushbutton board, thus performing the verify read-out function. In addition, the block contains a number of indicating lamps 75. These lamps are used to indicate the type of key being inserted in any room door, whether improper entry was being attempted, and whether the room was in use or vacant. Other useful information could be displayed in these units as well. For instance, it would be possible to ascertain the location of the hotel cleaning personnel. As was discussed above with reference to Figure 2, a column of slugs and holes 7 is used to identify the class of key being used, i.e. master, maid, guest. As will be appreciated by those familiar with the hotel industry, it is necessary that a maid's key be capable of opening several rooms and the master key be capable of opening any room. It is necessary, therefore to provide several memory locations in the computer for each room, one for each class of key. On issuing a key to a maid, the key would be inserted in the key data reader 11 (discussed above with reference to Figure 3) and the rooms to which access is to be allowed entered into the computer via the pushbutton board 12. A particular lamp on the verify read-out unit 13 contained on the panel at the front desk would then display the location of maids at any particular time.

WHAT WE CLAIM IS:—

1. A security system for controlling access to a plurality of enclosures, comprising a plurality of portable data-bearing devices each bearing a unique set of data, a computer having a memory location dedicated to each enclosure, means for receiving any one of the data-bearing devices and for simultaneously receiving enclosure identification data to direct the data of the received data-bearing device to the memory location of the enclosure identified by the received identification data, a bolting mechanism for each enclosure for normally bolting that enclosure and electrically connected to the computer, and a reader associated with each of said bolting mechanisms to receive any one of the data-bearing devices in which, when one of the data-bearing devices is inserted into the reader, signals corresponding to the data are transmitted to the computer where the data is compared with the data stored in the memory location of each said enclosure and, if the data being compared matches, the computer issues a signal to operate the bolting mechanism to allow access to the enclosure.

2. A security system for controlling access to a plurality of enclosures, comprising a plurality of portable data-bearing devices each bearing a unique set of data; a computer having a memory location dedicated to each of said plurality of enclosures; control data entry unit including means for receiving individual ones of the said data-bearing devices and for sensing the data borne by a said data-bearing device received thereby and means for entering enclosure identification data for any of the enclosures, said control data entry unit upon sensing the data borne by a said data-bearing device and upon entering of enclosure identification data therein, acting to produce outputs in accordance with the sensed data and enclosure identification data; means for connecting the output of said control data entry unit to said computer to provide storage of the sensed data at the memory location within said computer in accordance with the enclosure identification data contained in said outputs; a bolting mechanism for and at each enclosure, for normally bolting that enclosure, each of said bolting mechanisms including a solenoid for controlling the release of said bolting mechanism; a reader located at each enclosure for receiving any one of the said data-bearing devices and for sensing data borne by the received data-bearing device and for producing outputs in accordance with the data sensed; means for connecting the outputs of each said reader means to said computer, said computer being programmed to identify the sensed data output received from said reader with the corresponding enclosure, to compare the sensed data received from that reader with the corresponding data stored at the memory location dedicated to the corresponding enclosure, and if the sensed data and the corresponding data match, to produce an output signal to actuate the bolting mechanism of said corresponding enclosure to release the bolting mechanisim associated therewith to allow access to said corresponding enclosure, and in which said control data entry unit includes a register for receiving the enclosure identification; and means for initiating the operation of the computer to cause the storage of any data being sensed by the control data entry unit in the computer memory section dedicated to the identified enclosure.

3. A security system as claimed in Claim 2, wherein said reader includes means for transmitting a "request service" signal to said computer.

4. A security system as claimed in Claim 2 in which, when a data-bearing device is received by the control data entry unit and identification data for the enclosure is entered into the control data entry unit, said data-bearing device cancels any previous data in the computer memory section dedicated to the identified enclosure.

5. A security system as claimed in any one of Claims 2—4 including a data-bearing device with data thereon which, when said device is inserted into the control data entry unit and the identification of an enclosure is entered into said control data entry unit, cancels any previous data in the computer memory section dedicated to the identified enclosure and leaves the latter section blank.

6. A security system as claimed in any one of the preceding claims including a data display unit adapted to display information transmitted to it by the computer.

7. A security system as claimed in any one of the preceding claims in which each data-bearing device comprises a plurality of spaced-apart conducting slugs extending through a non-conducting body and arranged in a predetermined pattern, the pattern of each device being different from the patterns of the other data-bearing devices.

8. A security system as claimed in any one of the preceding claims including an alarm which is activated upon receipt of a signal from the computer indicating that the data being compared in the computer does not match.

9. An electronic security system substantially as described herein and illustrated in the accompanying drawings.

POTTS, KERR & CO.

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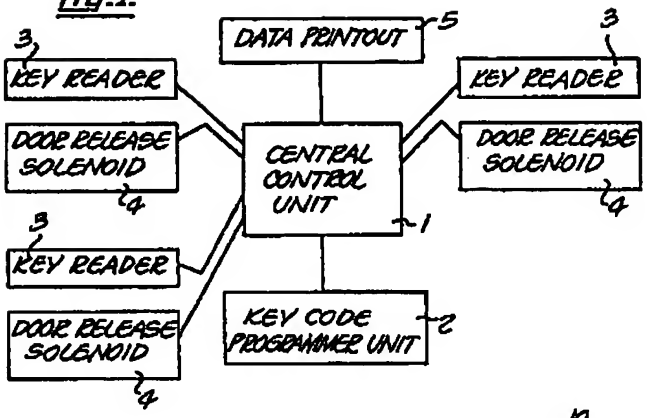
1330184 COMPLETE SPECIFICATION
5 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

Fig.1.



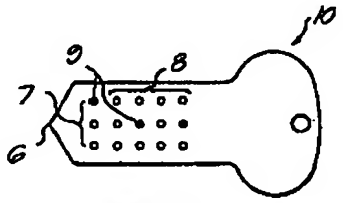


Fig.2.

Fig. 3.

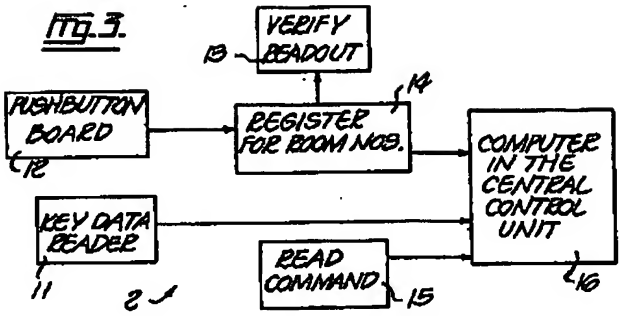
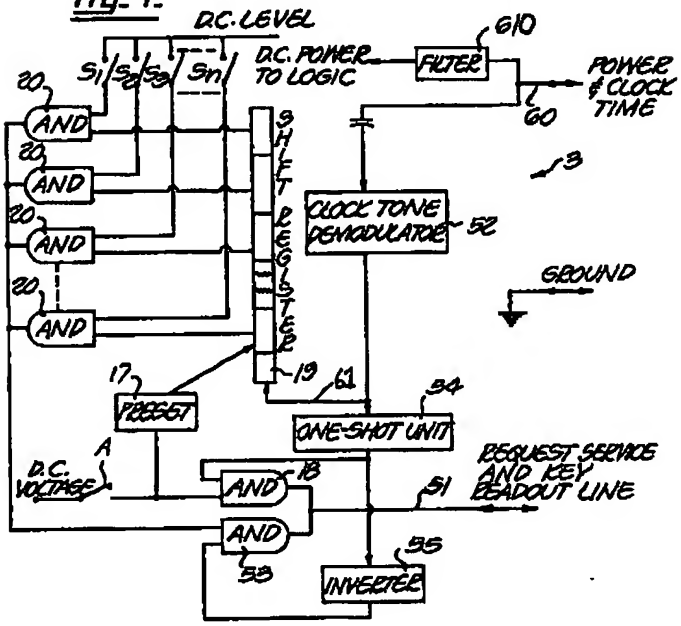

VERIFY READOUT
13
14
PUSHBUTTON BOARD
12
REGISTER FOR ROOM NOS.
COMPUTER IN THE CENTRAL CONTROL UNIT
KEY DATA READER
11
2
READ COMMAND
15
16

Fig. 4.


D.C. LEVEL
S1
S2
S3
Sn
D.C. POWER TO LOGIC
610
FILTER
POWER & CLOCK TIME
60
3
20
AND
SHIFT REGISTER
CLOCK TONE DEMODULATOR
52
GROUND
17
19
61
54
PRESET
ONE-SHOT UNIT
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D.C. VOLTAGE
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REQUEST SERVICE AND KEY READOUT LINE
51
55
INVERTER
53

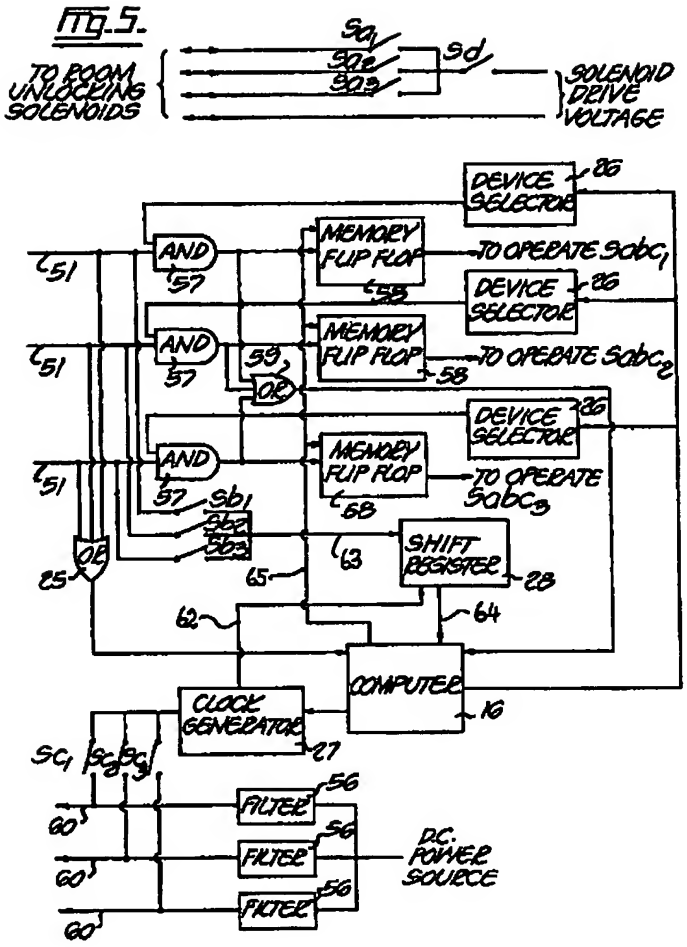
Fig. 5.
TO ROOM UNLOCKING SOLENOIDS
SOLENOID DRIVE VOLTAGE
DEVICE SELECTOR
AND
MEMORY FLIP FLOP
TO OPERATE
SHIFT REGISTER
COMPUTER
CLOCK GENERATOR
FILTER
D.C. POWER SOURCE

1330184 COMPLETE SPECIFICATION
5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 4

FIG. 6.

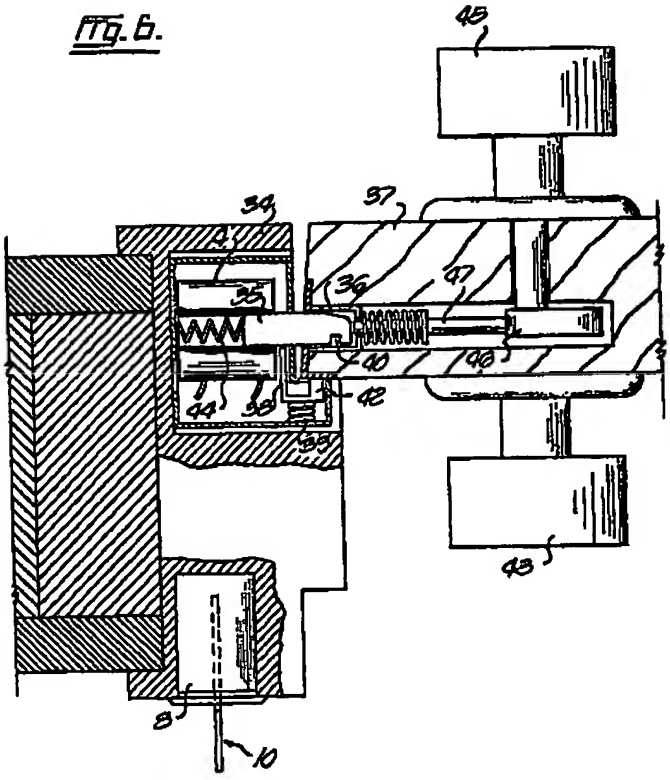

Fig. 7.

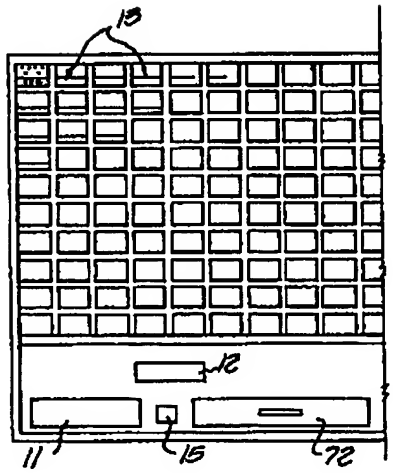
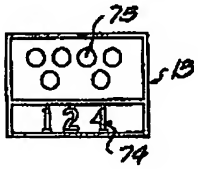
Fig. 8.